ORIGINAL ARTICLE

The role of the C-reactive protein to lymphocyte ratio in the diagnosis of complicated acute appendicitis

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ABSTRACT

BACKGROUND: To assess the diagnostic value of the C-reactive protein to lymphocyte ratio (CLR) and other inflammatory markers in distinguishing complicated from uncomplicated acute appendicitis (AA) to support timely surgical intervention.

METHODS: This retrospective study included 682 patients who underwent appendectomy between January 2018 and January 2021. Based on the histopathological American Association for the Surgery of Trauma (AAST) AA grading system, patients were classified as complicated AA (grades 3–5; n=144) or uncomplicated AA (grades 1–2; n=538). Preoperative laboratory values—white blood cell (WBC) count, neutrophil count, C-reactive protein (CRP), sodium (Na), CLR, neutrophil-to-lymphocyte ratio (NLR), and CRP/Na—were analyzed. Diagnostic performance was assessed using receiver operating characteristic (ROC) analysis.

RESULTS: Complicated AA cases were significantly older (37.5±17.6 vs. 30.0±12.8 years; p<0.001). CRP (7.17±6.78 vs. 2.98±4.52 mg/dL), WBC, neutrophils, and CLR (5.66±9.13 vs. 1.89±3.94) were significantly elevated in the complicated group (p<0.001). CLR showed moderate diagnostic accuracy (AUC=0.712), with a cutoff of ≥2.82 yielding 53.5% sensitivity and 82.7% specificity (OR=5.49, 95% CI: 3.69–8.16). Hyponatremia and elevated NLR/PLR also correlated with complications.

CONCLUSION: CLR is a moderately accurate, highly specific, and accessible biomarker for identifying complicated AA. Its integration with clinical evaluation may enhance preoperative risk stratification, especially in resource-limited settings.

Keywords: Acute; appendicitis; biomarkers; c-reactive protein; ınflammation mediators; lymphocyte count.

INTRODUCTION

Acute appendicitis (AA) is a prevalent surgical emergency that often necessitates urgent intervention and is a primary cause of abdominal pain presenting in emergency department settings.[1,2] The lifetime incidence of acute appendicitis is estimated to be 8.6% in men and 6.9% in women.[3] Timely diagnosis and intervention are crucial in preventing the onset of complications.[4] Mortality risk in patients with AA is 0.3%; however, this risk increases to 0.6% in cases of perforation.[5,6] Determining whether a patient has complicated AA is crucial when planning treatment. Complicated AA can be identified in the presence of gangrene, perforation, or abscess formation.[7,8] In recent years, it has been suggested that uncomplicated AA may be treated solely with antibiotics.[9,10] However, despite being effective and safe, non-operative treatment carries a risk of recurrent AA of up to 40% within five years.[11] On the other hand, patients with complicated AA should not be treated with antibiotics alone because they may have

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perforated AA. Guidelines recommend that patients with complicated AA should undergo surgery as soon as possible, or at least within 8 hours of diagnosis.[12]

Computed tomography (CT) is frequently utilized in clinical practice to assess the severity of AA. However, considering the radiation exposure and the loss of radiologist workload, a practical laboratory test capable of predicting this condition is still being sought. Among systemic inflammatory parameters, studies have demonstrated an association between the severity of AA and laboratory parameters such as the neutrophil-to-lymphocyte ratio (NLR), platelet-to-lymphocyte ratio (PLR), monocyte-to-eosinophil ratio (MER), and C-reactive protein (CRP).[13,14] Additionally, the CRP-to-lymphocyte ratio (CLR) is a promising marker for detecting complicated AA.[15,16]

The objective of our study is to identify laboratory markers that can effectively distinguish between complicated and uncomplicated AA in patients presenting to the emergency department with a preliminary diagnosis of AA.

MATERIALS AND METHODS

This study was performed as a retrospective analysis of patients diagnosed with AA who underwent surgical intervention in the Department of General Surgery between January 2018 and January 2021.

Historical records of patients were evaluated retrospectively from a prospectively recorded database. Patients younger than the age of 18 years, patients with a history of ongoing inflammatory diseases such as arthritis, inflammatory bowel disease, and familial Mediterranean fever were excluded. Additionally, patients who underwent appendectomy alongside another surgical procedure or for stump appendicitis were not included.

Demographic data (age, gender), type of surgery, intraoperative findings, preoperative hemogram and biochemical parameters, and physical examination findings were recorded. All patients were arranged for follow-up appointments one week and one month after surgery, on an outpatient basis.

Pathology reports were reviewed and categorized according to the American Association for the Surgery of Trauma (AAST) AA grading system. The AAST classification grades AA severity from 1 to 5: Grade 1 – acutely inflamed, intact appendix; Grade 2 – intact, gangrenous appendix; Grade 3 – perforated appendix with localized contamination; Grade 4 – perforated appendix with periappendiceal phlegmon or abscess; and Grade 5 – perforated appendix with generalized peritonitis.[17] Patients with grades 1–2 were classified as having uncomplicated AA, while those with grades 3–5 were categorized as having complicated AA.

All procedures followed the ethical guidelines set forth in the 1964 Helsinki Declaration and its later revisions. Approval from the Institutional Review Board (IRB) was granted [IRB number: 2023/0814], and informed consent was obtained from all participants.

Descriptive statistics were presented as counts (percentages) for categorical variables and as mean ± standard deviation, median (range) for continuous variables. The normality of continuous variables was assessed both analytically using the Kolmogorov-Smirnov test and visually through graphical methods. Differences in patient characteristics and preoperative laboratory values between the complicated and uncomplicated AA groups were compared using Pearson's chi-squared test for categorical variables, and either the Independent Sample t-test or the Mann-Whitney U test for continuous variables. Standardized effect sizes (Cohen's d) for group differences in laboratory data were calculated based on the respective z-test statistic values.

The diagnostic performance of laboratory parameters with significant p-values from group comparisons was evaluated through receiver operating characteristic (ROC) curves and the area under the curve (AUC). The optimal cutoff values for potential biomarkers were determined using the Youden Index, and sensitivity, specificity, along with their 95% confidence intervals (CI), were calculated. All statistical analyses were conducted using the Statistical Package for the Social Sciences (SPSS, Version 11.5, SPSS Inc., Chicago, IL), and a p-value of less than 0.05 was considered indicative of statistical significance.

RESULTS

The study group consisted of 682 surgically treated AA cases. The mean age of patients in the complicated AA group (n=144) was 37.5±17.59 [median: 37.5 (18-90)] years, while the mean age of patients in the uncomplicated AA group (n=538) was 30.0±12.76 [median: 30.0 (18-88)] years. The age of patients in the complicated AA group was significantly higher than in the uncomplicated group (p<0.001) (Table 1).

Regarding gender distribution, 62 women (43.1%) and 82 men (56.9%) were in the complicated AA group, while 186 women (34.6%) and 352 men (65.4%) were in the uncomplicated group. The difference in gender distribution was not statistically significant (p=0.06).

The distribution of surgical procedures was evaluated, and it was found that 130 patients (90.3%) in the complicated AA group were treated with laparoscopic surgery, 6 patients (4.2%) underwent conversion to open surgery, and 8 patients (5.6%) were treated with conventional open surgery. In the uncomplicated group, these rates were 505 patients (93.9%), 12 patients (2.2%), and 21 patients (3.9%), respectively. No statistically significant difference was observed between the groups regarding the type of surgery performed (p=0.287) (Table 1).

According to the intraoperative grading of appendicitis, 33 cases were inflamed (22.9%), 59 cases were phlegmonous (41.0%), 34 cases were perforated with localized free fluid (23.6%), 13 cases were perforated with regional abscess

Table 1. Evaluation of the age, gender, type of surgery, and perioperative findings of patients between the groups

		Complicated (n=144)	Non-complicated (n=538)	P
Gender				
Female	n (%)	62 (43.1)	186 (34.6)	0.06
Male	n (%)	82 (56.9)	352 (65.4)	
Age (years)	Mean±SD	37.5±17.59	30.0±12.76	<0.001
	Median (min-max)	37.5 (18-90)	30.0 (18-88)	
Operation type				
Laparoscopic	n (%)	130 (90.3)	505 (93.9)	0.287
Conversion to open surgery	n (%)	6 (4.2)	12 (2.2)	
Conventional	n (%)	8 (5.6)	21 (3.9)	
Intraoperative grade				
Inflamed	n (%)	33 (22.9)	290 (53.9)	<0.001
Phlegmonous	n (%)	59 (41.0)	207 (38.5)	
Perforated with localized free fluid	n (%)	34 (23.6)	30 (5.6)	
Perforated with regional abscess formation	n (%)	13 (9.0)	9 (1.7)	
Perforated with diffuse peritonitis	n (%)	5 (3.5)	2 (0.4)	

Pearson's chi-squared test, Mann-Whitney U test.

(9.0%), and 5 cases were perforated with diffuse peritonitis (3.5%) in the complicated AA group. In the uncomplicated group, these rates were 290 cases (53.9%), 207 cases (38.5%), 30 cases (5.6%), 9 cases (1.7%), and 2 cases (0.4%), respectively. In the complicated AA group, inflamed cases were at a lower rate, while perforated cases were significantly higher (p<0.001) (Table 1).

The laboratory parameters are summarized in Table 2. In the complicated AA group, the mean WBC count was 15.26±4.09 x 10^3/µL [median: 14.8 (5.1-31.3)], the mean neutrophil count was 12.66±3.83 x 10^3/µL [median: 12.4 (2.9-25.8)], and the mean neutrophil percentage was 82.25±6.7% [median: 83.6% (57.2%–94.7%)]. In the uncomplicated group, these values were 14.08±4.2 x 10^3/µL [median: 13.5 (3.4-36.9)], 11.37±6.1 x 10^3/µL [median: 10.7 (1.8-31.2)], and 76.8±10.43% [median: 76.9% (42.4%-95.3%)], respectively. In the complicated AA group, WBC, neutrophil, and neutrophil percentage values were significantly higher (p<0.001).

The CRP level was found to be 7.17±6.78 mg/L [median: 5.53 (0.2-29.5)] in the complicated group and 2.98±4.52 mg/L [median: 1.5 (0.1-45.7)] in the uncomplicated group, being significantly higher in the complicated group (p<0.001). The sodium (Na) level was 136.14±2.49 mmol/L [median 136 (126-141)] in the complicated group and 137.14±2.21 mmol/L [median: 137 (124-143)] in the uncomplicated group. According to these results, Na levels were significantly higher in the uncomplicated group (p<0.001).

The CRP/neutrophil percentage, CRP/neutrophil, CRP/Na, and CLR ratios were calculated as 0.086±0.08 [median 0.063 (0.001-0.39)], 0.625±0.645 [median: 0.484 (0.008-3.68)], 0.051±0.05 [median: 0.041 (0.002-0.29)], and 5.66±9.126 [median: 3.19 (0.2-77.5)], respectively, in the complicated group. In the uncomplicated group, these ratios were 0.039±0.057 [median: 0.024 (0.001-0.7)], 0.33±0.565 [median: 0.162 (0.006-7.76)], 0.022±0.033 [median: 0.013 (0.001-0.47)], and 1.89±3.942 [median: 0.92 (0.05-41.8)], respectively. These ratios were significantly higher in the complicated AA group (p<0.001). Lymphocyte counts were calculated as 1.89±1.47 x 10^3/µL [median: 1.56 (0.2-7.8)] in the complicated group and 2.18±1.23 x 10^3/µL [median: 2.0 (0.1-10.8)] in the uncomplicated group. The lymphocyte levels were significantly higher in the uncomplicated group (p<0.001).

The ROC analysis of laboratory parameters is summarized in Table 3 and Figure 1. According to these findings, CRP (AUC: 0.710), CRP/lymphocyte ratio (AUC: 0.712), and CRP/Na ratio (AUC: 0.712) had high diagnostic accuracy. CRP showed 52.1% sensitivity and 81.8% specificity at a cutoff value of ≥5.11, and CRP/Na ratio showed 52.1% sensitivity and 80.3% specificity at a cutoff value of ≥0.035.

At a CLR cutoff value of ≥2.82, sensitivity was 53.5% and specificity was 82.7%. The odds ratio (OR) of the CLR was calculated as 5.487 (95% CI: 3.691-8.156); the positive predictive value was 45.3%, and the negative predictive value was 86.9% (Table 4).

DISCUSSION

Acute appendicitis is a disease characterized by a rapidly developing inflammatory response and variable clinical severity.

Table 2. Distribution of laboratory data of patients by groups

	Complicated (n=144)	Non-complicated (n=538)	P
WBC, (x10³/μL)			
Mean±SD	15.26±4.09	14.08±4.20	0.001
Median (min–max)	15.25 (4.40-26.90)	13.60 (4.20–27.80)	
Neutrophil, (x10³/μL)			
Mean±SD	12.66±3.83	11.37±6.10	<0.001
Median (min–max)	12.42 (3.56-23.09)	10.63 (2.25-87.50)	
Neutrophil percentage			
Mean±SD	82.25±6.70	76.8±10.43	<0.001
Median (min–max)	83.25 (63.10-94.70)	78.30 (9.23–94.70)	
CRP, (mg/L)			
Mean±SD	7.17±6.78	2.98±4.52	<0.001
Median (min–max)	5.50 (0.10-28.17)	1.17 (0.10-32.30)	
Sodium, (mmol/L)			
Mean±SD	136.14±2.49	137.14±2.21	<0.001
Median (min–max)	136.00 (127.00-141.00)	137.00 (129.00-144.00)	
CRP/ Neutrophil percentage			
Mean±SD	0.086±0.08	0.039±0.06	<0.001
Median (min–max)	0.06 (0.00-0.33)	0.02 (0.00–0.38)	
CRP/Neutrophil			
Mean±SD	0.625±0.65	0.33±0.57	<0.001
Median (min–max)	0.41 (0.00-2.89)	0.12 (0.00-4.31)	
CRP/Sodium			
Mean±SD	0.051±0.05	0.022±0.033	<0.001
Median (min-max)	0.04 (0.00-0.21)	0.01 (0.00–0.24)	
CRP/Lymphocyte			
Mean±SD	5.66±9.13	1.89±3.94	<0.001
Median (min-max)	3.13 (0.00-83.80)	0.63 (0.02-40.37)	
Lymphocyte, (x10³/μL)			
Mean±SD	1.89±1.47	2.18±1.23	<0.001
Median (min–max)	1.70 (0.30-16.00)	2.00 (0.40-22.10)	
Platelets, (x10³/μL)			
Mean±SD	247.38±65.03	247.63±62.33	0.732
Median (min–max)	238.50 (102.00-499.00)	245.00 (44.00-705.00)	
Neutrophil/Lymphocyte			
Mean±SD	9.07±6.21	6.71±5.82	<0.001
Median (min–max)	7.37 (0.88-50.63)	5.16 (0.69-67.31)	
Platelets/Lymphocyte			
Mean±SD	172.20±103.50	138.31±83.11	<0.001
Median (min–max)	154.03 (19.75-780.00)	120.53 (13.26-980.00)	

Mann-Whitney U test, CRP: C-Reactive Protein, WBC: White Blood Cell.

[18] Laboratory parameters play an important role in the differentiation of complicated and uncomplicated cases. Recent studies have shown that inflammatory markers such as CRP, neutrophil-to-lymphocyte ratio (NLR), and CRP-to-lymphocyte ratio (CLR) can be strong indicators for predicting the severity of the disease.[19] The diagnostic accuracy of CRP and NLR is particularly notable in the early detection of complications and the optimization of clinical interventions.[20]

Table 3. Receiver Operating Characteristic analysis results of laboratory parameters

Variables	AUC	Cutoff	P Value	Sensitivity (%)	Specificity (%)
WBC	0.595	≥13.85	0.001	64.80	52.70
Neutrophil	0.617	≥9.62	<0.001	79.60	40.60
CRP	0.710	≥5.11	<0.001	52.10	81.80
CRP/Neutrophil	0.676	≥0.29	<0.001	61.80	69.60
CRP/Sodium	0.712	≥0.035	<0.001	52.10	80.30
CRP/Lymphocyte	0.712	≥2.82	<0.001	53.50	82.70
Neutrophil/Lymphocyte	0.654	≥7.77	<0.001	50.00	73.40
Platelets/Lymphocyte	0.611	≥153.36	<0.001	50.00	70.40
Sodium	0.619	≤135.50	<0.001	36.80	80.60
Lymphocyte	0.619	≤1.65	<0.001	49.30	69.30

AUC: Area Under the Curve, CRP: C-Reactive Protein, WBC: White Blood Cell. AUC, cutoff, sensitivity, and specificity values were calculated using ROC curve analysis and the Youden Index.

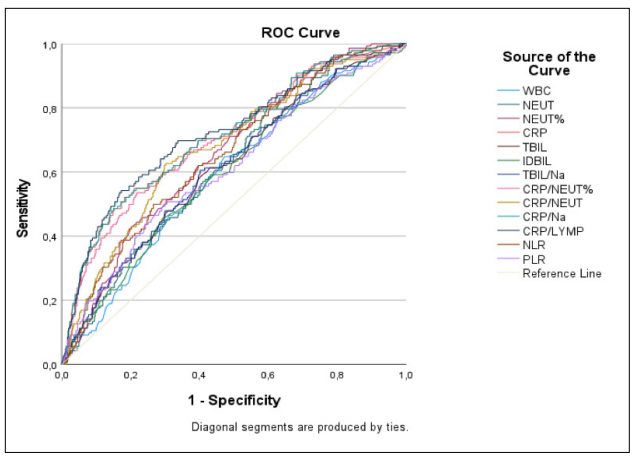

Figure 1. Receiver Operating Characteristic curve analysis of laboratory parameters.

Table 4. Receiver Operating Characteristic analysis of C-reactive protein to lymphocyte ratio

	Value	Lower	Upper
Sensitivity	0.535	0.500	0.618
Specificity	0.827	0.792	0.858
Positive Predictive Value	0.453	0.395	0.513
Negative Predictive Value	0.869	0.847	0.888
Positive Likelihood Ratio	3.09	2.43	3.92
Negative Likelihood Ratio	0.56	0.47	0.67

Values calculated via Receiver Operating Characteristic (ROC) analysis with 95% confidence intervals.

Furthermore, CLR appears to have potential as a sensitive biomarker that can assist in surgical decision-making.[21] The findings of this study may shed light on how the combination of inflammatory parameters can be used to improve clinical management in cases of AA.

Advanced age is an important factor that increases the risk of complicated AA.[22] Xu et al.[23] reported that older patients had a higher risk of perforation in their study. In the present study, the mean age of patients in the complicated AA group was 37.5±17.59 [median: 37.5 (18-90)] years, which is significantly higher than the mean age of 30.0±12.76 [median: 30.0 (18-88)] years in the uncomplicated group (p<0.001).

The effect of gender on AA complications remains unclear. Doğan et al.[24] reported that the effect of gender on the development of complications was limited and did not make a significant difference in determining the severity of AA. In our study group, the proportion of female and male patients in the complicated AA group was 25% and 18.9%, respectively. In the uncomplicated group, the proportion of women was 75% and men 81.1%. However, this difference was not statistically significant (p>0.05).

As expected, complicated AA cases present greater challenges for surgeons. Higher rates of conversion from laparoscopic to open surgery are observed in complicated cases.[25] In our study, 90.3% of patients in the complicated group underwent laparoscopic surgery, 4.2% underwent conversion to open surgery, and 5.6% underwent conventional surgery. On the other hand, in the uncomplicated group, laparoscopic surgery was performed in 93.9% of cases. Although the conversion and conventional surgery rates were lower in the uncomplicated group, these differences did not reach statistical significance (p>0.05).

Perforation is more common in complicated AA cases, and early surgical intervention is required. Similarly, the presence of perforation has been shown to be an important predictive factor for the severity of complicated AA cases.[26] When intraoperative appendicitis grading results were analyzed, inflamed appendicitis was found in 33 (22.9%) of the complicated AA cases, while patients with perforation consisted of 34 (23.6%) cases with the presence of localized free fluid, 13 (9.0%) cases with regional abscess formation, and 5 (3.5%) cases with diffuse peritonitis. In contrast, the rate of inflamed cases in the uncomplicated group was as high as 53.9%, while perforation rates were 5.6% for the presence of localized free fluid, 1.7% for regional abscess formation, and only 0.4% for diffuse peritonitis. As expected, intraoperative findings were associated with a higher rate of perforated cases in the complicated AA group (p<0.001).

Neutrophil count, WBC, and CRP are the most frequently used inflammatory parameters in daily clinical practice. Güngör et al. reported that CRP and neutrophil counts were reliable diagnostic markers for complicated AA.[27] In our study, the CRP level was 7.17±6.78 mg/dL, WBC was 15.26±4.09 x 10^3/μL, and neutrophil count was 12.66±3.83 x 10^3/μL in the complicated group. These values in the uncomplicated group were 2.98±4.52 mg/dL, 14.08±4.2 x 10^3/μL, and 11.37±6.1 x 10^3/μL, respectively. All these differences were statistically significant (p<0.001).

Another important parameter indicating the severity of the inflammatory response is NLR, which has been reported to have high predictive value for detecting complicated AA cases.[15] In the present study, NLR was also found to be significantly higher in the complicated AA group (p<0.001).

Recent studies have reported that CLR was effective in determining the severity of AA and has high diagnostic accuracy.[21,28] In our study, CLR was found to be 5.66±9.126 in the complicated group and 1.89±3.942 in the uncomplicated group (p<0.001). Accordingly, CLR with a cutoff value of ≥2.82 exhibited a sensitivity of 53.5% and a specificity of 82.7%, indicating that this parameter was a reliable biomarker for distinguishing complicated AA cases (OR=5.487; 95% CI=3.691–8.156, p<0.001). These findings support that CLR was a strong biochemical indicator for predicting the risk of complications in clinical practice, as the risk of complicated AA was found to be approximately sixfold higher in cases with a CLR value equal to or above 2.82.

The pathophysiology of hyponatremia, a known complication in inflammatory conditions, is still under investigation. It has been suggested that this condition is related to immunoneuroendocrine pathways and is due to the effect of interleukin-6 level alterations on vasopressin.[29] Low Na levels are more common in complicated cases and are associated with the severity of inflammation.[30] In our study, Na levels were significantly lower in the complicated AA group (p<0.001). These findings suggest that hyponatremia could also be used as a marker in determining complicated AA cases and was associated with the severity of the inflammatory process.

Oymaci et al.[31] reported that PLR was an effective marker in distinguishing complicated AA cases. PLR was found to be 172.20±103.50 in the complicated group and 138.31±83.11 in the uncomplicated group (p<0.001). These findings indicate that elevated PLR could be considered a potential indicator in the clinical management of AA patients as well.

This study has several limitations. Firstly, the retrospective design restricted the findings to the data that were available. Furthermore, the study was carried out at a single center, which may limit the generalizability of the results. Additionally, the inflammatory parameters were measured only at admission preoperatively, which may not adequately reflect the dynamic changes of the inflammatory response.

CONCLUSION

In conclusion, the findings of our study demonstrated that CLR was an important biomarker for the early detection of complicated AA cases. Inflammatory markers such as CRP, NLR, and CLR play a significant role in clinical and surgical decision-making. Especially, the high specificity and sensitivity values of CLR emphasize this parameter as an independent prognostic factor. The findings of this study suggest that CLR can be widely used in clinical practice and may be an important tool, particularly when access to imaging methods is limited, as this inflammatory biomarker is simple to measure and calculate.

Ethics Committee Approval: This study was approved by the Göztepe Prof. Dr. Süleyman Yalçın Research and Training Hospital Ethics Committee (Date: 29.11.2023, Decision No: 2023/0814).

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ORİJİNAL ÇALIŞMA - *ÖZ*

Komplike akut apandisit tanısında C-reaktif protein/lenfosit oranının rolü

AMAÇ: Bu çalışmanın amacı, komplike ve komplike olmayan akut apandisit (AA) olgularını ayırt etmede C-reaktif protein/lenfosit oranı (CLR) ile diğer inflamatuvar belirteçlerin tanısal değerini değerlendirmek ve zamanında cerrahi müdahaleye katkı sağlamaktır.
GEREÇ VE YÖNTEM: Ocak 2018-Ocak 2021 tarihleri arasında apendektomi uygulanan 682 hasta retrospektif olarak incelendi. Hastalar, Amerikan Travma Cerrahisi Derneği (AAST) akut apandisit histopatolojik evreleme sistemine göre komplike AA (evre 3–5; n=144) ve komplike olmayan AA (evre 1–2; n=538) olarak sınıflandırıldı. Preoperatif beyaz küre (WBC), nötrofil sayısı, C-reaktif protein (CRP), sodyum (Na), CLR, nötrofil/lenfosit oranı (NLR) ve CRP/Na düzeyleri analiz edildi. Tanısal performans, ROC analizi ile değerlendirildi.
BULGULAR: Komplike AA olguları anlamlı şekilde daha ileri yaş grubundaydı (37.5±17.6 vs. 3.0±12.8 yıl; p<0.001). CRP (7.17±6.78 vs. 2.98±4.52 mg/dL), WBC, nötrofil ve CLR (5.66±9.13 vs. 1.89±3.94) düzeyleri komplike grupta anlamlı derecede yüksekti (p<0.001). CLR, AUC=0.712 ile orta düzeyde tanısal doğruluk gösterdi; ≥2.82 eşik değeriyle %53.5 sensitivite ve %82.7 spesifiteye ulaşıldı (OR=5.49, %95 GA: 3.69-8.16). Hiponatremi ve artmış NLR/PLR de komplikasyonlarla ilişkili bulundu.
SONUÇ: CLR, komplike akut apandisit tanısında orta derecede duyarlı, yüksek özgüllüğe sahip ve kolay erişilebilir bir biyobelirteçtir. Klinik değerlendirme ile birlikte kullanıldığında, özellikle kaynakların kısıtlı olduğu ortamlarda preoperatif risk sınıflandırmasını destekleyebilir.

Anahtar sözcükler: Apandisit; biyobelirteçler; c-reaktif protein; inflamasyon; lenfosit sayısı.

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